

OSC028- Biology (Genetics) (draft 10.30.2020)

Credit Hours: 3-4 Semester Hours

Pre-Requisite: OSC003 (Biology I) or Equivalent

General Course Description:

This course explores general genetics problems and processes as they are experienced by all biological systems: the nature of genetic materials, transmission/patterns of inheritance, molecular biology of gene function, gene expression and regulation, genetic variation, evolution and population genetics, comparative genetics/methods and tools and genetics and bioethics. With the evolving nature of the field it is critical for a bioethics component to be embedded in this course. Lectures include a standard modern general biology genetics text designed for introductory biology genetics for science majors to provide a strong basis for learning. Student Learning Outcomes (SLOs) are aligned with the core concepts and competencies which have been identified as foundational for undergraduate biological genetics literacy by the Genetics Society of America.

Core Concepts include:

- I. Nature of Genetic Materials**
- II. Transmission/Patterns of Inheritance**
- III. Molecular Biology of Gene Function**
- IV. Gene Expression and Regulation**
- V. Genetic Variation**
- VI. Evolution and Population Genetics**
- VII. Comparative Genetics/Methods and Tools**
- VIII. Genetics and Bioethics**

In order for a course to be approved for OSC028 - Biology (Genetics), all of the following must be met:

- 1) Student Learning Outcomes (SLOs) marked with an asterisk (*) are required.
- 2) A minimum of 70% of the Student Learning Outcomes, including essential outcomes marked with an asterisk (*), must be met.

CORE CONCEPTS:

I. NATURE OF GENETIC MATERIALS

What are the nature, structure and function of genetic components found in different biological systems.

1. Compare the molecular nature and structure of genetic materials found in prokaryotic and eukaryotic cells as well as bacterial, animal and plant viruses. *
2. Describe the molecular and cellular mechanisms involved in DNA replication. *
3. Explain genetic repair processes expressed in different biological systems.
4. Summarize the relationships between genome replication and different states of the cell cycle in prokaryotes and eukaryotes.

II. TRANSMISSION/PATTERNS OF INHERITANCE

What are the mechanisms by which an organism's genome is passed on to the next generation.

1. Describe the mechanism by which prokaryote and eukaryote genomes are transmitted to the next generation. *
2. Recall the stages of meiosis and indicate what is happening during each stage. *
3. Describe organelle genetics. *

How can one deduce information about genes, alleles, and gene functions from analysis of genetics crosses and patterns of inheritance.

1. Follow alleles over several generations using Punnett squares and Mendelian terminology. *
2. Analyze pedigrees to determine patterns of inheritance, including sex linkage. *
3. Analyze data from a population to determine the influence of alleles versus the environment on phenotypes.

How does the phenomenon of linkage affect the assortment of alleles during meiosis.

1. Describe genetic linkage and the role homologous recombination plays in allele transmission. *
2. Explain the relationship between chromosomes and sex determination. *

III. MOLECULAR BIOLOGY OF GENE FUNCTION

How is genetic information expressed so it affects an organism's structure and function.

1. Explain how the genetic code relates transcription to translation. *
2. Discuss how various factors might influence the relationship between genotype and phenotype (e.g. incomplete penetrance, variable expressivity, and sex-limited phenotype). *
3. Explain how abnormalities in gene dosage can affect phenotype.
4. Describe how changes in the number of triplet repeats can alter gene function and phenotype.

IV. GENE EXPRESSION AND REGULATION

How can gene activity be altered in the absence of DNA changes.

1. Discuss the roles of types of RNA other than mRNA in expressing genetic information. *
2. Describe the similarities and differences in eukaryotic and prokaryotic gene expression. *
3. Contrast the packaging of DNA into euchromatin versus heterochromatin in the context of histone modification, and DNA modification. *
4. Discuss the potential roles of DNA modification, histone modification, and non-coding RNA in epigenetic inheritance, both in somatic and germline. *

How do genes and genomes control changes in an organism's structure and function throughout its life cycle.

1. Describe how differential histone modification modulates gene activity and is utilized in developmental progression. *
2. Explain how polarity is established in a developing embryo using gene expression gradients. *
3. Use a model system to describe investigations of evo-devo.
4. Describe genetic cascades; use the sex-determination cascade to explain how differential gene expression can result in the development of different sexes.

V. GENETIC VARIATION

Describe how different types of mutations may affect gene function and explain the potential impact that mutations may have on the corresponding mRNAs and proteins produced by the cell.

1. Describe how mutations affect phenotype. *
2. Compare the conditions that result from different types of chromosome variations in humans.
3. Explain the role of chromosome variation in plants. *
4. Identify and describe the different types of transposable elements.
5. Explain the role of transposition on individual organisms and evolution.
6. Describe the impact of mutations on different classes of genes and their role in the development of cancer.
7. Describe the impact of epigenetic changes on cancer genetics.
8. Describe how genetic material can be transferred among microbial cells.

VI. EVOLUTION AND POPULATION GENETICS

What are the processes that can affect the frequency of genotypes and phenotypes in a population over time.

1. Explain the difference between organismal and population genetics. *
2. Apply Hardy-Weinberg equilibrium to population genetics. *
3. Describe the influence of population genetics on evolution.

VII. COMPARATIVE GENETICS/METHODS AND TOOLS

Making comparisons between organism toward greater understanding of human genetics.

1. Describe the genetic conditions currently being treated using genetic therapy.
2. Explain methods of genetic testing. *
3. Discuss the characteristics of the model organisms that make them useful for comparison to human genetics.

What experimental methods are commonly used to analyze gene structure, gene expression, gene function, and genetic variants.

1. Describe techniques used to obtain and analyze genomic and proteomic information. *
2. Explain the importance of model organisms to the understanding of human genetics.
3. Describe methods used for gene editing and gene therapy (e.g. CRISPR).
4. Explain the process and use of various experimental methods involving recombinant DNA technology.
5. Describe the use of recombinant DNA technology in biotechnology.

VIII. GENETICS AND BIOETHICS

1. Identify and critique scientific issues relating to biology ethics in genetics (e.g. genetic testing and gene editing). *